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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/748,174
Filing Date: December 31, 2003
Appellant(s): TROSMAN ET AL.

Gary D. Yacura (Reg. No.: 35,416)
Corey E. Smith (Reg. No.: 57,807)
HARNESS, DICKEY & PIERCE, P.L.C.
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 9/28/09 appealing from the Office action mailed 11/19/08.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

A Board of Patent Appeals & Interferences Decision was rendered on March 31, 2008 for related application 10/748,175 affirming the examiner.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

Said statement implies that no amendments were filed after final rejection as appealed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,735,267	Orii et al	05-2004
5,068,082	Ueda et al.	11-1991

5,229,068 Johansson et al. 07-1993

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

BEGINNING OF GROUNDS OF REJECTION of record in the appealed office action mailed 11/19/2008 referencing the grounds of rejection as set forth in the Office action mailed 1/9/2008 in turn referencing the grounds of rejection as set forth in the Office action mailed 12/20/2006, without any change intended:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 24 and 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Orii et al., and further in view of Ueda et al. and Johansson et al.

Orii et al. teach a structure that encompasses the basic inventive concept of the current application, i.e., a fuel bundle having water passages with circular or square cross-sections located either centrally or proximal to the center. In particular, Fig. 15 is identical to the elected embodiment that is described by the claimed (claims 24 and 28) features except that the rod subsets in a mirror-image long the center line between the

two water passages are pairs rather than triplets. That is, Fig. 15 shows the following features of a fuel bundle for a boiling water reactor:

• a generally square, hollow tube having four sides which are configures as sides of the bundle,

• a pair of water passages located adjacent to a longitudinal centerline of the tube so as to extend centrally through the tube, the pair of water passages supported by one or more rod supports,

• a first part-length rod group including two part-length fuel rod subsets in a mirror-image along the centerline between the two-water passages, each subset further comprising two part-length fuel rods,

• a second part-length rod group including tour pair of part-length rods, each part-length rod pair centrally located in the outermost row or column of the lOxl0 matrix adjacent a corresponding one of the four sides of the tube.

Fig. 15 depicts a fuel bundle having twelve part-length fuel rods. The deficiency ofOrii et al. is clearly acknowledged above, and there is no suggestion in the appealed rejection that Orii et al. anticipate the claimed fuel bundle.

Ueda et al. show that it is a well-known and advantageous expedient in the art to provide certain groupings of part-length rods, particularly a 3-rod subgroup adjacent to a water passage (39) (see Fig. 19; col. 12, lines 53-66). Applicant has not shown how the 3-rod group is functionally distinct from the 2-rod group such that it is not an obvious variant. As such, the inclusion of a third rod is no more than the duplication of parts with predictable and intended effects. See In re Itarza, 274 F.2d 669, 124 USPQ 378 (CCPA

1960). Part-length rods serve to ensure the maintenance of the reactor Shut-down margin, and having a 3-rod grouping modulates this effect in a predictable fashion. In other words, there is no unexpected result that directly depends on the specifically claimed configuration. Therefore, the skilled artisan desiring to duplicate the effect of one of the rods in a 2-rod subset in the interest of modulating the shut-down margin would be motivated to provide a 3-rod subset. Making this obvious modification would inevitably result in adding two part-length fuel rods to the original twelve, resulting in fourteen part-length fuel rods (claim 27).

Ueda et al. disclose a plurality of voids formed above the upper ends of the shorter, or part-length, fuel rods (Fig. 25A) (claims 26, 29 and 32). Moreover, it is inherent to fuel bundles including part-length rods that there would be voids at the end of the shorter rods. Claims 26 and 29 are essentially reciting the absence of the portion of part-length rods that distinguishes them from full-length rods. The "void" feature is therefore structurally equivalent to the "part-length rods" feature, the object of which is to improve shutdown. As to limitations which are considered to be inherent in a reference, note the case law *ofIn re Ludtke,* 169 U.S.P.Q 563; *In re Swinehart,* 169 U.S.P.Q. 226; *In re Fitzgerald,* 205 U.S.P.Q 594; *In re Best et al.,* 195 U.S.P.Q. 430; and *In re Brown,* 173 U.S.P.Q. 685,688.

Johansson et al. teach that the addition of part length rods lowers the pressure drop, thereby improving critical power. Note that reactor "shutdown" refers to the state of the reactor when it is subcritical (not producing sufficient neutrons to sustain fission chain reactions) by at least a margin defined in the reactor's technical specifications - i.e.,

"shutdown margin" is understood in the nuclear art to be a metric of criticality and power. Some particularly relevant teachings of Johansson et al. include the following:

"Numerous advantages result from the part length rod construction. Improved cold shut down margin enables fuel to be designed with reduced amounts of burnable absorbers such as gadolinium. The tendency of the fuel bundle in the reactor to produce plutonium at the top of the bundle from resonance neutron capture in uranium 238 is reduced. The void overlying the part length rod has an increased vapor fraction with the result that the full length rods adjacent the voids have an increased liquid fraction. Further, the pressure drop in the upper two phase region of the fuel bundle is reduced. This being the case, the fuel bundle enjoys increased stability from thermal hydraulic and nuclear instabilities" (col. 2, lines 3-15).

The number and arrangement of part-length rods is therefore a matter of optimization within prior art conditions or through routine experimentation (See MPEP § 2144.05 II.A). The concept of including part-length rods in a fuel assembly in order to modulate shutdown is well-known (Ueda et al. column 12, line 65), and an optimization of a presently disclosed device is not considered patentably distinct from the original device.

It would have been obvious to one skilled in the art at the time of the invention to combine the aforementioned teachings - e.g., by placing the 3-rod group taught by Ueda et al. in the configuration taught by Orii et al., and applying the power modulation teachings provided by Johansson et al in order to provide the benefits that are the disclosed objects of all of the referenced prior art, particularly an improved shutdown margin, as part of an optimization of a known technology.

Claims 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Orii et al and Johansson et al.

Orii et al. teach a structure that encompasses the basic inventive concept of the current application, i.e., a fuel bundle having water passages with circular or square

cross-sections located either centrally or proximal to the center. In particular, Fig. 20 shows the following features of a fuel bundle for a boiling water reactor:

• a single, square-shaped water passage located off-center within a 10XI0 fuel-rod matrix bounded by four sides of a generally square, hollow tube, the fuel rods including full-length and part-length fuel rods,

• a first rod group comprising two pairs of part-length rods arranged on either side of a corner of the square water passage; and a second rod group comprising two pairsof part- length rods,

• wherein each of the two pairs of part-length rods is located in a corresponding outermost row or column of the matrix adjacent a corresponding side of the tube.

Fig. 20 depicts an additional two pairs of part-length rods rather than two non-paired part-length rods as recited in claim 31. This prior art embodiment comprises a total of twelve part-length rods.

With regard to the void feature of claim 32, it is inherent to fuel bundles including part-length rods that there would be voids at the end of the shorter rods. Claim 32 is essentially reciting the absence of the portion of part-length rods that distinguishes them from full-length rods. The "void" feature is therefore structurally equivalent to the "part-length rods" feature, the object of which is to improve shutdown. As to limitations which are considered to be inherent in a reference, note the case law of In re Ludtke, 169 U.S.P.Q 563; In re Swinehart, 169 U.S.P.Q. 226; In re Fitzgerald, 205 U.S.P.Q 594; In re Best et al., 195 U.S.P.Q. 430; and In re Brown, 173 U.S.P.Q. 685,688.

Johansson et al. teach that the addition of part length rods lowers the pressure drop,

thereby improving critical power as set forth in section 5 above. The number and arrangement of part-length rods is therefore likewise a matter of optimization within prior art conditions or through routine experimentation (See MPEP § 2144.05 II.A). It would have been obvious to one of Ordinary skill in the art at the time of invention to modify the arrangement of part-length rods depicted in Fig. 20 ofOrii et al. to have either two (claim 31) or three (claim 33) non-paired rods as part of an optimization of a known technology. The beneficial effects of using part-length rods are known and predictable, and the skilled artisan would be motivated to optimize these effects by producing part-length rod arrangements tailored to the neutronic environment in any given part of the reactor core. Moreover, making the aforementioned additional pairs, of part-length rods into non-paired rods is no more than the omission of an element and its function where the element is not desired. *In re Larson,* 340 F.2d 965, 144 USPQ 347 (CCPA 1965). This modification would result in an embodiment that encompassed every feature of claim 31.

END OF GROUNDS OF REJECTION

(10) Response to Argument

A. On the arguments of appeal of the rejections of claims 24 and 26-29 under 35 USC 103(a) as being unpatentable over Orii et al (US 6,735,267) in view of Ueda et al (US 5,068,082) and Johansson et al (US 5,229,068:.

Appellant's first argument of appeal is that Orii et al *"specific fuel rod patterns, shown in Figs. 2-23, were discovered through the rigorous application of Orii's conditional Equations, and significant calculations and additional experimentation would*

be required to further modify Orii's fuel rod patterns while ensuring that Orii's Equations remain satisfied" (see pages 13-14 of the Appeal brief).

Examiner disagrees, because, *rather than Equations, conditions underlying Orii's embodiments are Inequalities*, thus leaving latitude for compliance. Appellant in said first argument also cites the wrong set of "Equations": as pointed out earlier, not "Equations 1-6 but instead conditions 1, 3, 4, 6, 11 and 15 form the basis for the (fourth) embodiment on which the rejection is based (col. 3, l. 14-44, Fig. 15). As pointed out earlier in Response to Arguments of the appealed Office action, page 7, the stable, hatched zone pertaining to the fourth embodiment (Figure 15) includes the modification that supplements the teaching by Orii et al to arrive at the claimed invention.

Furthermore, examiner disagrees also because appellant has not shown any criticality in the feature that provides the only distinction between the claimed invention and the prior art as disclosed by Orii et al, in particular their fourth embodiment. No unexpected results are shown that are related to the short-length nature of the fuel rods that are shown as full length in Orii et al but claimed to be part-length in the claimed invention. While there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness, "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 127 S.Ct. at 1741. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a

person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

Id. at 1742. In this instance, there are a finite number of identified, predictable possibilities with regard to the arrangement of intermediate- and short-length rods in a reactor fuel assembly. Furthermore, this finite number is further limited by conditions in the form of Inequalities, through misnomer characterized as "Equations" which further guide the selection of rod configurations.

Examiner also refers in this regard to the reasons provided by the Board of Appeals and Interferences for affirmation of examiner's grounds of rejection in related application 10/748,175, especially pp. 10-11.

Appellant's second argument of "*improper replacement of rigorous calculations and experimentation with mere speculation*" (page 15) is contradicted by the very conditions that form the basis for Orii's embodiments. Examiner had previously shown that the conditions 1, 3, 4, 6, 11 and 15 are met for the combined invention (see page 7 of the Office action (11/19/08). Therefore, no rigorous calculations or experimentation need to be performed to assure the combination of reasonable expectation of success.

Appellant's third argument is based on the distinction between "interposed" and "short-length" fuel rods (Ueda et al teaches "interposed" (pages 16-17), meaning short effective length). In the conditions by Orii et al it is the *effective* length of the fuel rods that is subjected to an inequality, i.e., the portion packed with fuel, and hence the

"interposed" fuel rod not only meets part-length fuel rod but also is a short fuel rod within the context of the invention by Orii et al. Furthermore, any non-fuel material, whether water or any other non-nuclear-fuel portion of the fuel rods, would increase absorption relative to reactivity and as such allow the optimization taught by Johansson et al and Orii et al.

Appellant's fourth argument alleging Ueda's Fig. 19 is an 8x8 matrix is irrelevant for the obviousness argument, which does not rely thereon.

Appellant's fifth argument (page 18) on improper combination, alleging the combination with Ueda et al would destroy the specific teachings of Orii et al, again relying on what applicant calls "Equations", but which are in reality only Inequalities that very broadly constrain the parameter set that consists of the number of part-length fuel rods (n), the ratio of full-length rod length divided by part-length fuel rod length, the average burn-up, and the ratio of the total cross-sectional area of water rods divided by the total cross-sectional area of bottom portion coolant flow (col. 3, l. 37-43). Because implementation of the teaching by Ueda et al and Johansson et al in the invention according to the fourth embodiment of Orii et al (col. 12, l. 55 – col. 14, l. 16) evidently satisfies all so-called "Equations" or Inequalities, there is no question that the inventions can be combined and that there is no possibility that the specific teachings by Orii et al are destroyed: In particular, the stable, hatched zone (see col. 9, l. 3) in Figure 16 (pertaining to the fourth invention by Orii et al (see col. 5, l. 16-25 for the meaning of the "hatched zone") permits Awr/Ach=0.125, and Lp/Lf=0.5 (allowed by "Equation" 4), yielding 0.1074 for the numerical threshold for Awr/Ach on the right-hand-side defined

by "Equation" 15, requiring the ratio to be at least equal to a threshold value as provided by its right-hand side, thus allowing to meet the Inequalities defined by "Equations" 3 and 15 simultaneously, while the right-hand-side of "Equation" 6 equals 0.223(N.B.: ±0.001 for all values here). Clearly, the stable value of Awr/Ach = 0.125 satisfies 0.223 ≥ 0.149 ≥ Awr/Ach ≥ 0.1074 and hence is part of the domain that guides the specific embodiments disclosed by Orii et al.

Appellant's sixth argument alleging "inoperability" when combining Johansson et al with Orii et al and Ueda et al, and alleging that "combining Johansson et al and Ueda et al with Orii et al would violate the conditional Equations of Orii et al" and "as such would destroy Orii et al for its intended purpose" (see paragraph bridging pages 18-19). Examiner disagrees for the same reasons as for Appellant's first argument (see above), because said "Equations" are not equations but instead are inequalities, allowing for a sufficiently wide region in parameter space to correspond to acceptable solutions, and from which it is clear that a modification of Orii et al, Figure 15, so as to replace two specific full-length rods with rods having a part-length rod, still fulfils all conditions that are the basis for the fourth embodiment of Figure 15, with reference to the discussion under "Appellant's fifth argument" above and to the appealed office action (under f) on pages 6 and 7. Again, it is noted that Orii et al delineates based on *effective* length of the rods (see Orii et al, abstract), which is applicable to both Ueda's interposed rods (see Ueda et al, see explanation of P rods, col. 5, l. 4+ and col. 8, l. 20+) and to Johansson's contiguous short-length rods and that any non-fuel material, whether water or any other non-nuclear-fuel portion of the fuel rods, inherently increases absorption

relative to reactivity and as such allows the optimization taught by Johansson et al and Orii et al.

It is again noted that no criticality is indicated in the specification to be related to the part-length nature of those fuel rods that are disclosed in the fourth embodiment by Orii et al to be full length rods but are claimed by appellant to be part-length rods. No unexpected results are shown to flow from the distinction in this regard between the claimed invention and the prior art.

Appellant's seventh argument alleges that Orii et al requires conditions ("Equations") 1, 3, 4, 6, 11 and 15 to be met and that at no time does Orii et al suggest that other similar orientations involving part-length rods may be manipulated or attempted such that a skilled artisan would be motivated to openly experiment with placing more (or less) part-length rods within orientations already depicted within the provided figures (main paragraph of page 19).

Examiner disagrees, because, once again, for the combination said conditions are met (as shown in the appealed action, loc.cit.), and Orii et al do suggest said other similar orientations by virtue of posing said conditions, viz. col. 2, l. 18-22.

B. On the arguments of appeal of the rejections of claims 31-33 under 35 U.S.C. 103(a) as being unpatentable over Orii et al (US 6,735,267) in view of Johansson et al (US 5,229,068):

According to appellant's first argument, Orii et al do not teach the claimed invention (page 21). This was not stated to be so either in the rejection and hence is not persuasive. Furthermore, the only distinguishing feature of the claimed invention as

defined by claim 31 in comparison with the prior art (Orii et al) is the claimed non-paired part-length rods. *Appellant does not show any criticality* in the specification concerning the existence of non-paired part-length fuel rods. On the contrary: as discussed in paragraphs [0019]-[0024] of appellant's specification the particular embodiments including the claimed invention as illustrated by Figure 3 are "*exemplary in nature, and thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention*" (page 9, [0023]). No specific reason for having *non-paired* part-length rods in the outermost row are provided at all, yet this is the only difference with Orii et al. Furthermore, the Inequalities for the fifth embodiment to which Figure 20 belongs (i.e., Inequalities 1, 4, 8, 10, 16 and 17) are also satisfied if the fuel rods on the outermost row or column are for two of the pairs replaced by unpaired fuel rods because only the number of the second fuel rods, - which are the fuel rods with short effective length, enter into the Inequalities, while said number does not change. Evidently, because the Inequalities are satisfied effects aimed at by Orii et al are the same. Furthermore, addition of two part-length rods in Figure 20 by Orii et al following the general teaching by Johansson et al increases the parameter "n" from 12 to 14, which amply falls within the range for the fifth embodiment, as witnessed by Orii et al, stating that: "*In the present embodiment, the required number of the short length fuel rods 2B is within a range of 8 to 20 which is obtained from a study similar to that of Embodiment 1"* (col. 15, l. 10-13).

Furthermore, no unexpected results are shown that are related to the short-length nature of the fuel rods that are shown as full length in Orii et al but claimed to be

part-length in the claimed invention. While there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness, "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR,* 127 S.Ct. at 1741. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

Appellant's second argument is in its essence the same as appellant's first argument, i.e., alleging that Orii's conditional Equations prompt Orii et al to arrive at Fig. 20 only by meeting the conditions of what applicant interprets to be equations (page 22, first paragraph).

Examiner disagrees, because, *rather than Equations, conditions underlying Orii's embodiments are Inequalities*, thus leaving infinitely more latitude for compliance. Said Inequalities (1, 4, 8, 10, 16 and 17) by Orii et al are also satisfied if the fuel rods on the outermost row or column are increased by adding two or even four non-paired fuel rods in the outermost row or columns or if two of the pairs in the outermost row or column were replaced by unpaired fuel rods because only the number of the second fuel rods, - which are the fuel rods with short effective length, enter into the Inequalities, while said

number stays within the range stated by Orii et al (between 8 and 20). Evidently, because the Inequalities are satisfied effects aimed at by Orii et al are the same.

Appellant's third argument that the combination by Orii et al and Johansson et al would violate the conditional equations by Orii et al is unsubstantiated and is not true because the ranges indicated by the Inequality are satisfied for the combination, with reference to the discussion of appellant's second argument.

The overall conclusion by examiner is that for the reasons given above Appellant's arguments in support of the appeal of the rejections are not deemed to persuade.

(11) Related Proceeding(s) Appendix

Copies of the court or Board decision(s) identified in the Related Appeals and Interferences section of this examiner's answer are provided herein.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/JOHANNES P MONDT/

Primary Examiner, Art Unit 3663

Conferees:

/J. K./

Supervisory Patent Examiner, Art Unit 3663

/hcs/

Conferee